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Mean Place of Comparison Star.

Star.	Star's Name.	R.A. 1883·0.	N.P.D. 1883·0.	Authority.
		h m s	° ′ ″	
a	σ^2 Piscium	0 59 45·24	58 26 40·50	Green. Cat. 1872.

Note.—The sky clouded immediately after the comet was found; only one comparison could be obtained.

The observation is not corrected for refraction or parallax.

Royal Observatory, Greenwich:
1883, *March* 9.

Observations of the Great Comet (b) 1882, *made at Grahamstown, Cape of Good Hope.* By L. A. Eddie.

The comet was first observed on September 13 at 4.50 A.M. It had then just risen above the horizon, and appeared in the strong twilight as a brilliant but narrow band of ruddy light, terminating in a very bright nucleus, equalling *Jupiter* in brilliancy and apparent size. The tail was slightly inclined to the north, but seemed to have no curvature. It could be traced to about 12° from the nucleus. When viewed through my 9½-inch Calver, it appeared as an extremely bright and well-defined nucleus of a solid appearance, and shining with a light quite equal to that of *Venus*, but of a light golden hue; it was surrounded by a dense coma of a ruddy-brown tinge; there was no appearance of envelopes, and its periphery was very sharply defined. The nucleus seemed to contract as the daylight increased until it reached a limit where the still increasing light had no further diminishing effects on its size. This would seem to indicate a very dense centre to the nucleus.

September 15.—Morning clear. Head of comet rose at 5.3. The nucleus shone as bright as *Jupiter*, but no important details of physical structure were observed. The nucleus could be seen with the naked eye up to 5.40.

September 16.—The comet rose at 5.15. In the telescope the nucleus appeared less sharply defined on its preceding boundary, and the breadth of the coma was greater on the northern side than on the southern. The tail seemed to spread out for a short distance behind the comet, and it was darker in the centre, as if split open.

September 17.—The comet rose at 5.44, about 14 minutes before the Sun. It had increased still more in size and brilliancy. The head and tail, about 8′ in length, shone with intrinsic lustre. It was not to be eclipsed by the sunlight to-day at all, but continued to shine during the whole day as a bright attendant to the Sun, of 1° in length, and in which the cometary form was plainly discernible. So apparent was it to the naked eye, that one had but to look in the direction of the Sun when it could immediately be seen without any searching. However, as the day advanced it approached the Sun so very rapidly that at

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2 o'clock there was some little difficulty in screening the Sun from the view when looking at his attendant; and at 4.30 P.M. —which was the latest I was able to observe it, owing to its becoming obscured by clouds—it was so very close to the Sun as to be visible in the same field with this orb when observed through my 3-inch Refractor with a power of 50, being then about 14′ only from the Sun's western limb. In the 9-inch Calver this splendid object certainly presented a beautiful and imposing sight when it had risen sufficiently high to be free from the effects of the unsteadiness of the atmosphere in the vicinity of the horizon. The nucleus appeared as a solid globe glowing with a white light surpassing that of *Venus* when viewed in the daytime. The coma and tail for a short distance behind the head were also very brilliant. There was but little coma preceding the nucleus, so that the latter appeared as situated at almost the extremity of the tail. The coma was bounded on the margins by a denser stream of light than that composing its interior portion, and the northern side was narrower and brighter than the southern, but the southern extended further behind the nucleus than the northern. For this comet to have been not only visible during the whole day, but to have formed a conspicuous object in the heavens while in such close companionship with its brilliant ruler proves it to be the most brilliant comet of the present century, not excepting the great comet of 1843, which was also visible in full daylight, but not described as being visible during the whole day. To prove that it was not only visible in full daylight to one experienced in searching for heavenly bodies, I may here mention that my little girl, of only four years, was able to see it without difficulty up to about 1 o'clock, after her attention had been once directed to it. What is remarkable in this comet is that no great indications of perturbations taking place in its physical structure were observed while it approached the Sun, as is generally the case with these wonderful bodies, and especially with that of Comet *b* of 1881, as observed by myself.

September 19.—Comet observed at 8 A.M. about 4° N.W. of the Sun. It is now moving off in almost the same direction as it approached the Sun, so that it is apparently describing a very closed orbit of an elongated elliptical form.

September 20.—The comet rose at about 5.15 A.M. Though the head is decreasing in brightness, the tail has certainly greatly increased both in breadth and length. The tail appeared 5° in length and about $1\frac{1}{2}$° in width. It spread out suddenly to a breadth of nearly 1° at about 2° behind the nucleus, and then continued to open out at a less angle.

September 24.—On observing the comet at 4.30 A.M. a most glorious sight presented itself. The head of the comet had not yet risen, but a broad brilliant belt of rich golden light, about 2° in breadth, streamed upwards from the horizon for about 10°; and from the northern margin of this, again, a thin streak of less brilliant light extended upwards for about another 12°, and when

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the head had fully risen above the horizon at 4.43 A.M., there were about 25° in length of intensely luminous matter stretching upwards from a still more brilliant head, and inclined to the horizon at an angle of 70°. This glowing glory of light was more intensely brilliant on its margins, which represented two streams of incandescent gas flowing out from the preceding portion of the nucleus for a short distance, and then bent backwards so as to form the boundaries of its luminous appendage. The northern streamer was rather more brilliant than the southern, and possessed a slight bowing or outward curvature near the head of the comet, and further it was bounded on its interior edge by a dark rift or interval, which extended from the nucleus to nearly the termination of the broad part of the tail, and though it appeared very dark indeed when viewed with the luminous portion in close juxtaposition with it, it was nevertheless detected to possess a small degree of luminosity when viewed alone. The head appeared as before to consist of an apparently very solid though not very large nucleus, surrounded by a dense coma of no great extent, especially preceding the nucleus, and possessing no dark intervals, envelopes, or indeed any remarkable details as were so very conspicuous in Coggia's Comet of 1874, and in Comet *b* of 1881. As daylight advanced it soon became apparent that the comet, though not before seen to so great advantage, owing to its rising earlier, and consequently projected on a darker background, had greatly decreased in brilliancy and apparent size, for it was eclipsed by the increasing daylight, abont 12 minutes before sunrise, when *Jupiter* was yet plainly visible. The Sun rose about 4.49.

October 3.—The comet rose at 3·35, and could be then seen, through the dense fog that prevailed, like a great flame proceeding from a bonfire on the hills. At 4 A.M. when the fog had cleared away, it was at once perceptible that a great change in the structure of the comet had taken place. The tail was about 15° in length, and 3° in breadth at its extremity. The light was much more diffused throughout the whole length and breadth than before. The bright streams of light on the margins had disappeared; but the southern side was brighter, more sharply defined, and seemed to consist of denser matter than the northern, which was ragged in some parts, and shaded gradually in others. The dark rift which formed so conspicuous an object on September 24 was still present, but appeared to be closing up. There was a less sharply defined dark rift proceeding from the centre of the extremity of the tail to about $\frac{1}{4}$ its length towards the head, not parallel with the tail, but, following it with the eye from west to east, it appeared to incline more to the northern margin. The long, but faint, extension of the tail on the southern side was not visible; but this was probably owing to the strong moonlight, for when the tail was viewed by a side glance, a slight extension of the southern margin beyond the northern could be traced. The intense brilliancy of the tail to about two degrees behind the nucleus,

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which was plainly perceptible in this comet even when viewed in the daytime, has almost entirely left, and seems to be diffused throughout the whole tail, so that the extremity is now almost as brilliant as the portion immediately behind the nucleus. The head and one-fourth of the northern margin of the tail to about 3° behind the head were shrouded by a faintly luminous envelope of very rare matter one-fourth of a degree in width. The southern margin of the tail was, as I have already stated, very sharply defined, and possessed a slight though decided curvature.

On examining the nucleus with the 9½-inch Calver, to my astonishment I observed that it consisted of two distinct ellipsoidal nuclei in juxtaposition, each of them brighter on the interior edge and drawn out as it were towards the comet's ulterior boundary so that their conjugate axes were about double their transverse. They closely resembled, in the inverting telescope, the flames of two candles placed the one above the other, so that the uppermost part of the lower flame almost overlapped the lower portion of the other. There was a dark rift the breadth of the transverse axes of these nuclei extending from the hindermost one into the tail. These two nuclei were not parallel with the axis of the comet, but the foremost was drawn as it were, to the south or nearer to the direction in which the comet is moving. These two gaseous bodies appeared exactly as the double star *α Centauri* when viewed through a cloud with a low power. When the daylight had partly advanced they could be seen in the telescopic field perfectly free from the light of the surrounding matter forming the coma. This goes to prove what I have above stated, that the brilliancy of the matter immediately around and behind the nuclei has now greatly declined, for a considerable portion of the luminous matter forming the coma and tail was always visible on former occasions in the telescopic field when observing the nucleus, even at midday and when close to the Sun.

The comet became invisible this morning at 5.17, when the first-magnitude stars were yet shining brightly. The Sun rose at 5.35.

October 4.—Comet this morning very beautiful, owing to the sky being perfectly free from cloud or mist of any description. At 4 o'clock the prolongation of the southern margin of the tail could be traced for a short distance beyond the normal tail. The dark rift extending the whole length of the tail was still less distinct, and seems to be fast disappearing. The thin gauze envelope around the head and part of the tail is becoming more extensive, being in some parts nearly one degree in width, and it appears to melt into and form a continuation of the gradual shading off of the northern margin of the tail, which was this morning much less ragged. If it were not for the strong moonlight this thin veil would form a very beautiful and conspicuous feature in this comet. When viewed through the finder it appeared sharp and well-defined, and extended for a considerable distance beyond the nuclei. The nuclei this morning were dis-

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tinctly divisible viewed in the Reflector with powers of 60 and 100. They appeared if anything smaller than yesterday. The preceding nucleus was larger and brighter than the other, and they resembled in shape two grains of rice placed end to end.

October 8.—The dark rift that extended through the tail near its southern margin has entirely left, though the appearance of longitudinal streaks is still more apparent on this side. The abnormal tail could be traced for about 3° beyond the normal tail, making a sort of ogee-shaped figure on the extremity of the southern margin of the latter. In the finder, the thin gauze veil observed October 4, which envelops the head, as it were, with a hood, could be distinctly seen spreading out on either side of the head and extending to a considerable distance in front of the head in a cometary form, but lost to vision or fading away at the extreme limit of the cone. The nucleus, when viewed with the 9-inch Calver, powers 60 to 100, was very indistinct, owing partly no doubt to the unfavourable state of the atmosphere for observation; the preceding portion of the nucleus was shining brightly and did not seem to have altered since I last saw it, but the following portion was as if drawn out, and the light condensed at either end of the longer axis, so as to give the whole nucleus a triple appearance, but without any distinct separation between the two parts as before observed, or between the three apparent centres of condensation; it resembled a bar of dim light threaded with three beads of greater brilliancy, the foremost a long oval one, the others round, smaller and less brilliant. The light of the waning moon was unfavourable to observing details in the structure of the comet.

October 9.—Morning clear, but wind very strong and atmosphere unsteady. The light midway in the length of the tail is rather dimmer than at either of the extremities. Nucleus had much the same indistinct triple form as yesterday, and is now surrounded by very little coma. The hood surrounding the head, when viewed through the finder, has still the same beautiful appearance.

October 11.—Morning very fine, with clear sky and steady atmosphere. The thin gauze hood to the head of the comet was faintly discernible to the naked eye for about $1\frac{1}{2}°$ in front of the nucleus, and this feature is still very beautiful in the finder. I obtained this morning a much more satisfactory view of the nuclei than I did on October 8 and 9. They have greatly altered in shape since I first detected the division, and they have also somewhat considerably opened out. The preceding nucleus is now much smaller and condensed into a very bright starlike point, from which spiral streams seem to emanate. The hindmost nucleus has become greatly elongated, and now possesses as it were two centres of condensation, and appears to be fast approaching to a further division. This elongated nucleus resembles a dumb-bell with the sphere towards the tail more oval than the other. When the splitting up of the nucleus was first discovered by me, the two portions

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resembled two oval flames brightest on their internal edges—that is, at the ends nearest the tail of the comet: now the present elongation of the inner nucleus also represents two oval flames, but whose external edges are brightest—that is, on the ends nearest to the extremity of the head of the comet. These flames seem to overlap one another, the dimmer edge of the foremost overlapping the brighter edge of the hindmost. The whole nucleus appears, when not quite resolved, as a beaded streak of light inclined at an angle to the axis of the comet towards the southern limit of the head. The northern extremity of the tail was very close to *Cor* (α) *Hydræ.* The normal tail was about 15° in length, and if we add to this about 3° prolongation of the southern margin, and 1½° or 2° of dim mist extending beyond the head, we shall have, as visible this morning, an object stretching over 20° of the heavens. The nucleus faded from sight at 4.55, just half-an-hour before sunrise, when α *Hydræ*, a second-magnitude star, was yet visible.

October 15.—Morning fine for observation. Observed comet from 2.46 A.M. Nucleus situated about 4° East by South of λ *Hydræ*, which star it grazed with northern edge of tail and extended upwards to a small fifth-magnitude star (27 *Hydræ*) a little south-west of α *Hydræ*. The prolongation of the southern margin terminated near another fifth-magnitude star (26 *Hydræ*). The northern margin was also drawn out, but not so far as the southern, giving the termination of the tail an appearance of two horns with a bright point, formed by these small stars, on each of the tips, the southern horn being longer than the northern. A faint mistiness resembling the fainter portions of the milky-way could be traced to about 10° beyond the southern prolongation of the tail, when viewed with an averted glance. The portion of the tail which had passed over λ *Hydræ* was situated 4° from the nucleus, and was about 2° in width. A sixth-magnitude star, υ^2 *Hydræ*, 1½° south-west of λ *Hydræ*, was shining through the tail. The head when viewed through the finder was still surrounded by the faint though beautiful and extensive cone of light forming the hood, which is rather wider on the northern than on the southern side.

The nucleus when viewed through the Reflector, power 60, still appeared of a triple nature, though the second and third points of light (counting from east to west) were connected. The preceding point, which was distinctly separated from the others, was very brilliant, and resembled in colour the electric light; the spiral streams proceeding from it could also be seen. The preceding condensation of the other portion of the nucleus (Point No. 2) was also tolerably brilliant; but the following condensation (Point No. 3) was much dimmer and less defined. With power 100, each of these condensations in the bar of light forming the hindermost portion of the nucleus seemed at times again doubled, so that the whole nucleus resembled a string of five ill-defined luminous beads, or as one of the chords of an abacus threaded with five shining beads, the lower—or, as they

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appeared in the inverted telescopic field, the upper—the brightest and separated from the remainder, which graduated in brilliancy from the highest to the lowest. Comet faded from sight at 4.41; Sun rose at 5.20.

October 16.—The southern extension of the tail was visible for a long way beyond the termination of the normal tail when the comet rose; but, cirri clouds having spread themselves across the sky, no observations could be made with the telescope.

October 21.—Nucleus still bears power 100 with the 9½-inch Calver. The beaded appearance is now still more apparent. The brightest point, which before formed the foremost or more eastward, is now shorn of the spiral streams which emanated from it, but it is preceded by another faint point of light some distance away, with which it is connected by a hazy light. This will, in description, now form the first point. The third is also a tolerably bright point, but not nearly so bright as the second, from which it is still separated by a dark interval. This point followed by three other points of less brilliancy, enveloped as it were in a mist. The most westward of these points was only visible at intervals. The whole object resembled a sextuple star, divided by a dark interval into two groups, consisting respectively of two and four components, and each of these groups surrounded by a nebulous mist, the components of both groups being in one straight line, perpendicular to the line of sight.

October 23.—Sky clear. Comet shining brightly, no perceptible change to the unaided eye. Nucleus bore power 100 well. It now forms in the mirror a very conspicuous elongated objected studded as it were with six twinkling stars. The new point (Point No. 1) preceding the brightest point (Point No. 2) was this morning brighter and separated a little farther from the latter than on October 21. The dark interval between the two portions of this compound nucleus is still very apparent, and the force that produced this rupture seems still to be active in these two portions of the original nucleus, but to be acting in opposite directions in each. This is apparent by the fact that the preceding portion has formed a new point or jet in front or eastward, while the following portion has formed three points or jets behind or westward. This beaded bar of light composing this wonderful nucleus measured this morning about 1′ 15″ in length. All the bright points were better defined than I have yet observed them. The comet faded from sight at 4.35 A.M.; the Sun rising at 5.10 A.M.

October 29.—Nucleus in telescope fairly distinct; all six points discernible. No. 1 point appeared rather further removed, otherwise the whole streak forming the nucleus seemed shorter and fainter, from its being now at a much greater distance from the earth. The tail, however, was nothing diminished in length, though of course the prolongation of the southern margin can no longer be seen, owing to the bright moonlight.

November 1.—Nucleus presented no apparent change, except that it was more indistinct, so that the fifth and sixth points

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could not be detected, and the division between the two portions was very much smaller and less distinct.

November 2.—Morning fine; atmosphere clear; moon nearly the same altitude as comet, but considerably to its north. Nucleus was resolved into the six points by the 9½-inch mirror; the fifth and sixth require now a very clear morning in order that they may be detected, but this morning they were clearly visible. The two principal points, Nos. 2 and 3, were very bright.

November 10.—Sky covered more or less with cirri. Observed comet from 3.30 A.M. till eclipsed by daylight. Nucleus appeared to unaided eye much brighter and more star-like. With the mirror I was able to see all the points except the sixth, also the division between Points Nos. 2 and 3. The last formed point (No 1) has dimmed less than the others, or is, in other words, comparatively brighter than formerly. It is also now situated at a further distance from its neighbour than any of the others are from each other. The nucleus was visible to the naked eye up to 4.20—that is, thirty-three minutes before sunrise, which was at 4.53. This fact shows that there is apparently no diminution in the light of the nucleus since October 23 last, when, according to my own observations of that date, the comet faded from sight at 4.35 A.M. (the Sun rising at 5.10) or thirty-five minutes before sunrise. Its apparent movement is at present very small.

Ncvember 17.—Comet visible for a short time from 2.30 A.M. to 3.15 A.M. I could still, when using the 9½-inch Calver, detect at intervals five of the bright points in the nucleus. I thought Point No. 5 twinkled into sight more often than it had for some time back, while Point No. 1 could, on this occasion, scarcely be detected. Point No. 6 has now quite disappeared. These extremely tiny points of light, situated as it were in a nebulous mist, and revealing themselves at intervals on very favourable nights only, by their twinkling do indeed present a wonderful phenomenon.

November 24.—Sky clear; moon nearly full and very bright. The nucleus of the comet when viewed in the telescope still presented the appearance of a bar of light, but I could distinguish only two of the points of light, which I could not identify.

November 27.—Nucleus in 9½-inch Calver appeared granulous.

November 31.—The tail of the comet is still about 12° in length, and rather wider than formerly. The extremity has greatly altered in form, being now very much curved downwards to the east, in the form of a shepherd's crook, and closely resembling an ostrich plume with a drooping tip. The extremity is fully 6° in width. On examining the nucleus in the telescope, Point No. 1 could be seen very far removed from Point No. 2, which latter, together with No. 3, could be discerned on close observation.

December 2.—Sky hazy. Comet bright. The hooked extremity of tail plainly discernible.

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December 4.—Nucleus seen at intervals between the breaks in the clouds. Three of the points dimly visible: the streak of light, which now alone forms the centre of the nucleus, resembles a string of luminous beads almost hidden by a luminous gaseous veil stretched over them. A decided change is going on in the nucleus, which does not seem to be decreasing much in brilliancy at present. The tail was tolerably bright for about 8° from the nucleus, when it became very faint, and the "shepherd's crook" was scarcely visible. It was about 2° in width, at a distance of 4° from the head.

December 5.—Comet fainter. Nucleus oval and granulous.

December 9.—Comet resembles an elliptical nebula condensed along its conjugate axis. I can no longer detect the points.

The comet was observed on every day that it was visible from September 13 to December 14, the telescope employed being a $9\frac{1}{2}$-inch silvered-glass Reflector by Calver.

Grahamstown, Cape of Good Hope.

On the Magnifying Power of a Telescope. By J. M. Schaeberle.

(Communicated by W. H. M. Christie.)

I have lately devised a very simple arrangement by means of which the magnifying power of a telescope can be determined with almost any desired degree of accuracy. The only apparatus required is a thin wooden arm about two feet in length, by three or four inches in width at one end, tapering to an inch or less at the other end, and pierced by two fine needles, one near each end of the arm. The needle near the wide end is driven into a table, or any horizontal surface, and serves as an axis about which the arm can be revolved. Directly over this axis the eyepiece is placed in such a position that a narrow slit not more than $\frac{1}{100}$ of an inch in width (formed by fastening two pieces of tin or paper over the opening in the cap which covers the eye-end of the ocular) shall be coincident with the prolongation of the axis of rotation. The optical axis of the eyepiece having been made horizontal, the observer, stationed behind a second but wider slit placed at a distance of several feet from the ocular, and on the same level with it, marks the two positions of the arm (by pricking holes into the table with the other needle) at which the diffused light, passing first through the eyepiece, then through the narrow slit towards the observer, is occulted by the diaphragm in the focus of the eyepiece. If r denotes the distance between the needles, and d the distance between the two prickings in the table, the angle A, subtended by a diameter of the diaphragm, as seen through the eye-end of the ocular, will be given by the equation

$$\sin \tfrac{1}{2} \mathrm{A} = \frac{\tfrac{1}{2}d}{r}.$$

If t denotes the time required for a star, near the meridian